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Standard Practices

Learning Outcomes:

- ☒ Know the functions and limitations of traffic markings
- ☒ Understand the general principles of markings

Manual on Uniform Traffic Control Devices (MUTCD)

Note: The MUTCD can be downloaded from the FHWA website to supplement this manual:
<http://mutcd.fhwa.dot.gov>

MUTCD SECTION 3A.01 FUNCTIONS AND LIMITATIONS

Support: Markings on highways have important functions in providing guidance and information for the road user. Major marking types include pavement and curb markings, object markers, delineators, colored pavements, barricades, channelizing devices and islands. In some cases, markings are used to supplement other traffic control devices such as signs, signals and other markings. In other instances, markings are used alone to effectively convey regulations, guidance, or warnings in ways not obtainable by the use of other devices.

Markings have limitations. Visibility of the markings can be limited by snow, debris, and water on or adjacent to the markings. Marking durability is affected by material characteristics, traffic volumes, weather, and location. However, under most highway conditions, markings provide important information while allowing minimal diversion of attention from the roadway.

Pavement markings can enhance roadway delineation with the addition of audible and tactile features such as bars, differential surface profiles, raised pavement markers, or other devices intended to alert the road user that a delineation on the roadway is being traversed.

The general functions of longitudinal lines are:

- A. A double line indicates maximum or special restrictions,
- B. A solid line discourages or prohibits crossing (depending on the specific application),
- C. A broken line indicates a permissive condition, and
- D. A dotted line provides guidance.

MUTCD SECTION 3A.02 STANDARDIZATION OF APPLICATION

Standard: Each standard marking shall be used only to convey the meaning prescribed for that marking in this Manual. When used for applications not described herein, markings shall conform in all respects to the principles and standards set forth herein.

Guidance: Before any new highway, paved detour, or temporary route is opened to traffic, all necessary markings should be in place.

Standard: Markings that are no longer applicable for roadway conditions or restrictions and that might cause confusion for the road user shall be removed or obliterated to be unidentifiable as a marking as soon as practical. Markings that must be visible at night shall be retroreflective unless ambient illumination assures that the markings are adequately visible. All markings on Interstate highways shall be retroreflective.

Option: Markings may be temporarily masked with tape until they can be removed or obliterated.

MUTCD SECTION 3A.03 MATERIALS

Support: Pavement and curb markings are commonly placed by using paints or thermoplastics; however, other suitable marking materials, including raised pavement markers and colored pavements, are also used. Delineators, object markers, barricades, and channelizing devices are visibly placed in a vertical position similar to signs above the roadway.

Guidance: The materials used for markings should provide the specified color throughout their useful life.

Consideration should be given to selecting pavement marking materials that will minimize tripping or loss of traction for pedestrians and bicyclists.

Object markers and delineators should not present a vertical or horizontal clearance obstacle for pedestrians.

MUTCD SECTION 3A.04 COLORS

Standard: Markings shall be yellow, white, red, or blue. The colors for markings shall conform to the standard highway colors. Black in conjunction with one of the above colors shall be a usable color.

When used, white markings for longitudinal lines shall delineate:

- A. The separation of traffic flows in the same direction.
- B. The right edge of the roadway.

When used, yellow markings for longitudinal lines shall delineate:

- A. The separation of traffic traveling in opposite directions.
- B. The left edge of the roadways of divided and one-way highways and ramps.
- C. The separation of two-way left turn lanes and reversible lanes from other lanes.

When used, red raised pavement markers shall delineate roadways that shall not be entered or used.

When used, blue markings shall supplement white markings for parking spaces for persons with disabilities. When used, blue raised pavement markers shall indicate locations of fire hydrants along a roadway.

Option: Black may be used in combination with the above colors where a light-colored pavement does not provide sufficient contrast with the markings.

Support: When used in combination with other colors, black is not considered a marking color, but only a contrast-enhancing system for the markings.

MUTCD SECTION 3A.05 WIDTHS AND PATTERNS OF LONGITUDINAL PAVEMENT MARKINGS

Standard: The widths and patterns of longitudinal lines shall be as follows:

- A. A normal line is 100 to 150 mm (4 to 6 in) wide.
- B. A wide line is at least twice the width of a normal line. The width of the line indicates the degree of emphasis.
- C. A double line consists of two normal width parallel lines separated by a 4-6 inch space. D. A broken line consists of normal line segments separated by gaps.
- E. A dotted line shall consist of noticeably shorter line segments separated by shorter gaps than used for a broken line. The width of a dotted line shall be at least the same as the width of the line it extends.

Guidance: Broken lines should consist of 3 m (10 ft) line segments and 9 m (30 ft) gaps, or dimensions in a similar ratio of line segments to gaps as appropriate for traffic speeds and need for delineation.

Option: A dotted line for line extensions may consist of 0.6 m (2 ft) line segments and 0.6 m (2 ft) to 1.8 m (6 ft) gaps. A dotted line for lane drop/add markings may consist of 0.9 m (3 ft) line segments and 2.7 m (9 ft) gaps.

GENERAL PRINCIPLES - LONGITUDINAL PAVEMENT MARKINGS

Longitudinal pavement markings shall conform to the following basic concepts:

- Yellow lines delineate the separation of opposing traffic flows or mark the left edge of the pavement on divided highways and one-way roads.
- White lines delineate the separation of traffic flows in the same direction or mark the right edge of the pavement.
- Broken lines are permissive.
- Solid lines are restrictive.
- The width of a line indicates the degree of emphasis.
- Double lines indicate maximum restrictions.
- Raised pavement markers serve as position guides, and may supplement other types of markings.

LONGITUDINAL LINES

The following examples illustrate the application of the principles and standards set forth in the previous sections.

- A normal, broken, white line is used to delineate lanes where travel is permitted in the same direction on both sides of the line. Its most frequent application is as a lane line for a multi-lane roadway.
- A normal, broken yellow line is used to delineate the left edge of a travel path where travel on the other side of the line is in the opposite direction. A frequent application is as a centerline of a two-lane, two-way roadway where overtaking and passing is permitted.
- A normal, solid, white line is used to delineate the edge of a path where travel in the same direction is permitted on both sides of the line, but crossing the line is discouraged, but not prohibited. It is also used to mark the right edge of the pavement. Frequently, this is used as a lane delineation line when approaching an intersection. A wide solid white line is used for emphasis when crossing requires unusual care. Frequently, it is used to delineate left or right turn lanes.
- A double solid white line is used to delineate a travel path where travel in the same direction is permitted on both sides of the line, but crossing the line is prohibited. It is frequently used before obstructions guiding the driver to pass on either side of the obstruction.
- A double line consisting of a normal, broken, yellow line and a normal, solid, yellow line delineates a separation between travel paths in opposite directions permitting traffic that is adjacent to the broken line to pass “with care” and prohibiting traffic adjacent to the solid line from passing. This is a one direction, no-passing marking. It is used on two-way, two- and three-lane roadways to regulate passing. It is also used to delineate the edges of a lane where travel in either direction is permitted as a part of a left-turn maneuver.

To permit a left turn maneuver, the marking shall be placed with the solid lines on the outside and the dashed lines to the inside of the lane. Traffic adjacent to the solid line may only cross this marking during a left-turn maneuver.

- A double line consisting of two normal solid yellow lines delineates travel in opposite directions prohibiting passing in both directions. This is a two-direction, no-passing marking. Crossing this marking with care is permitted only when making a left turn. It is frequently used before an obstruction that must be passed on the right or to form a channelizing island separating traffic in opposite directions.
- A double, normal, broken yellow line delineates the edge of a lane where direction of travel periodically changes and the line serves as a centerline at some point. It is used for a reversible lane.
- A normal dotted line is used to delineate a line through an intersection or interchange area. It shall be the same color as the preceding line.
- A solid yellow line delineates the left edge of a travel path to restrict passing on the left or to delineate the left edge of each roadway of divided streets or highways, one-way roadways, and ramps in the same direction of travel.

TRANSVERSE MARKINGS

Transverse markings, which include shoulder markings, word and symbol markings, stop lines, crosswalk lines, speed measurement markings and parking space markings shall be white. However, transverse median markings shall be yellow. Blue and red are permitted under certain circumstances.

Because pavement markings are viewed from a low angle, transverse lines shall be proportioned to give visibility equal to that of longitudinal lines. Pavement marking letters, numerals, and symbols shall adhere to the Standard Alphabets for Highway Signs and Pavement Markings, in the MUTCD.

Excerpt from VDOT Road & Bridge Specifications Section 105:

105.12—Coordination of Plans, Standard Drawings, Specifications, Supplemental Specifications, Special Provisions, and Special Provision Copied Notes

The plans, Standard Drawings, these Specifications, supplemental specifications, special provisions, special provision copied notes, and supplementary documents are parts of the Contract. These Contract documents are defined in Section 101 - Definitions. A requirement occurring in one shall be as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete work. In case of a discrepancy, the following order of priority will apply, with the highest governing item appearing first and the least governing item appearing last:

- (a) Special provision copied notes. The pay items and pay units listed in the proposal have the same status as special provision copied notes.
- (b) Special provisions
- (c) Plans
- (d) Supplemental Specifications.
- (e) Specifications
- (f) Standard Drawings. Calculated dimensions, unless obviously incorrect, will govern overscaled dimensions.

Sketches, drawings, general notes and other written information that are not included in special provisions or special provision copied notes used in No Plan and Minimum Plan Concept projects will have the same status as plans.

MUTCD – MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES

Part 3 – Markings

Chapter 3B – Pavement and Curb Markings

Section 3B.01 Yellow Centerline Pavement Markings and Warrants

Figure 3B-1. Typical Two-Lane, Two-Way Marking Applications

Figure 3B-2. Typical Four-or-More Lane, Two-Way Marking Applications

Figure 3B-5. Method of Locating and Determining the Limits of No-Passing Zones at Curves

Section 3B.08 Extensions Through Intersections or Interchanges

Figure 3B-11. Typical Pavement Marking Applications

Section 3B.09 Lane Reduction Transition Markings

Figure 3B-12. Typical Lane Reduction Transition Markings

Chapter 3B. Pavement and Curb Markings

Section 3B.01 Yellow Centerline Pavement Markings and Warrants

Standard: Centerline pavement markings, when used, shall be the pavement markings used to delineate the separation of traffic lanes that have opposite directions of travel on a roadway and shall be yellow.

Option: Centerline pavement markings may be placed at a location that is not the geometric center of the roadway.

On roadways without continuous centerline pavement markings, short sections may be marked with centerline pavement markings to control the position of traffic at specific locations, such as around curves, over hills, on approaches to highway-railroad grade crossings, at highway- railroad grade crossings, and at bridges.

Standard: The centerline markings on two-lane, two-way roadways shall be one of the following as shown in Figure 3B-1:

- A. Two-direction passing zone markings consisting of a normal broken yellow line where crossing the centerline markings for passing with care is permitted for traffic traveling in either direction;
- B. One-direction no-passing zone markings consisting of a normal broken yellow line and a normal solid yellow line where crossing the centerline markings for passing with care is permitted for the traffic traveling adjacent to the broken line, but is prohibited for traffic traveling adjacent to the solid line; and
- C. Two-direction no-passing zone markings consisting of two normal solid yellow lines where crossing the centerline markings for passing is prohibited for traffic traveling in either direction.

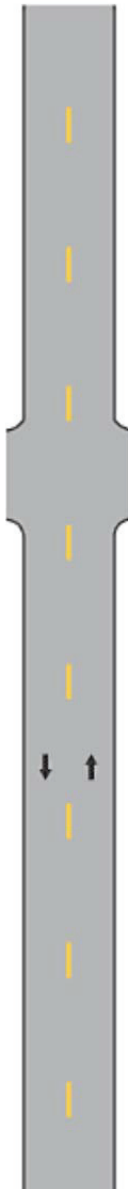
The centerline markings on undivided two-way roadways with four or more lanes for moving motor vehicle traffic always available shall be the two-direction no-passing zone markings consisting of two normal solid yellow lines as shown in Figure 3B-2.

Section 3B.08 Extensions Through Intersections or Interchanges

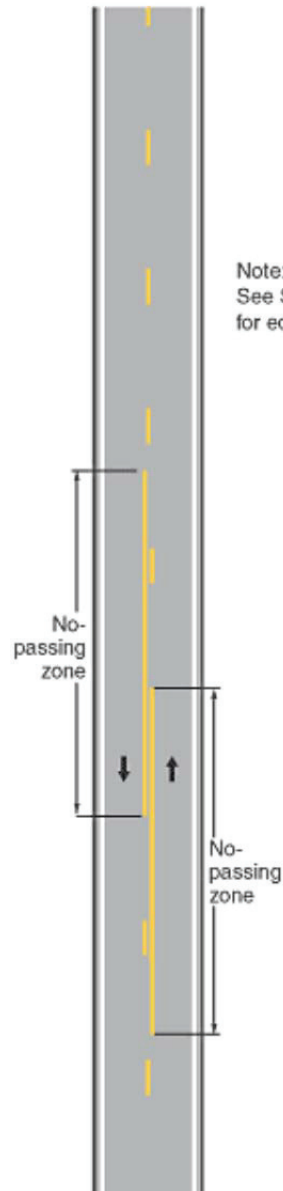
Standard: Pavement markings extended into or continued through an intersection or interchange area shall be the same color and at least the same width as the line markings they extend (see Figure 3B-11).

Figure 3B-1. Examples of Two-Lane, Two-Way Marking Applications

a - Typical two-lane, two-way marking
with passing permitted in both directions



b - Typical two-lane, two-way marking
with no passing zones



Legend
→ Direction of travel

Note:
See Section 3B.07
for edge line warrants.

Figure 3B-2. Examples of Four-or-More Lane, Two-Way Marking Applications

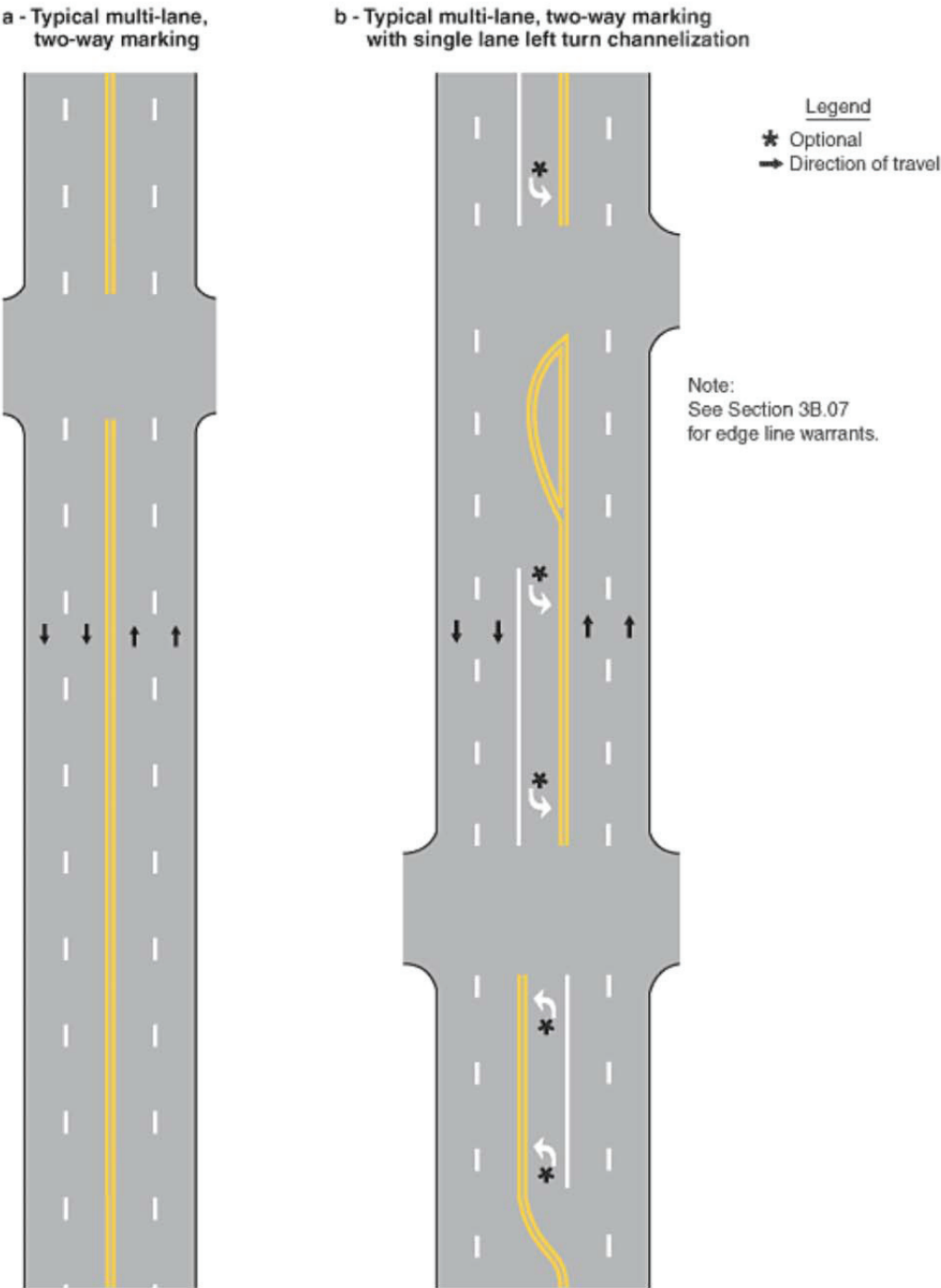
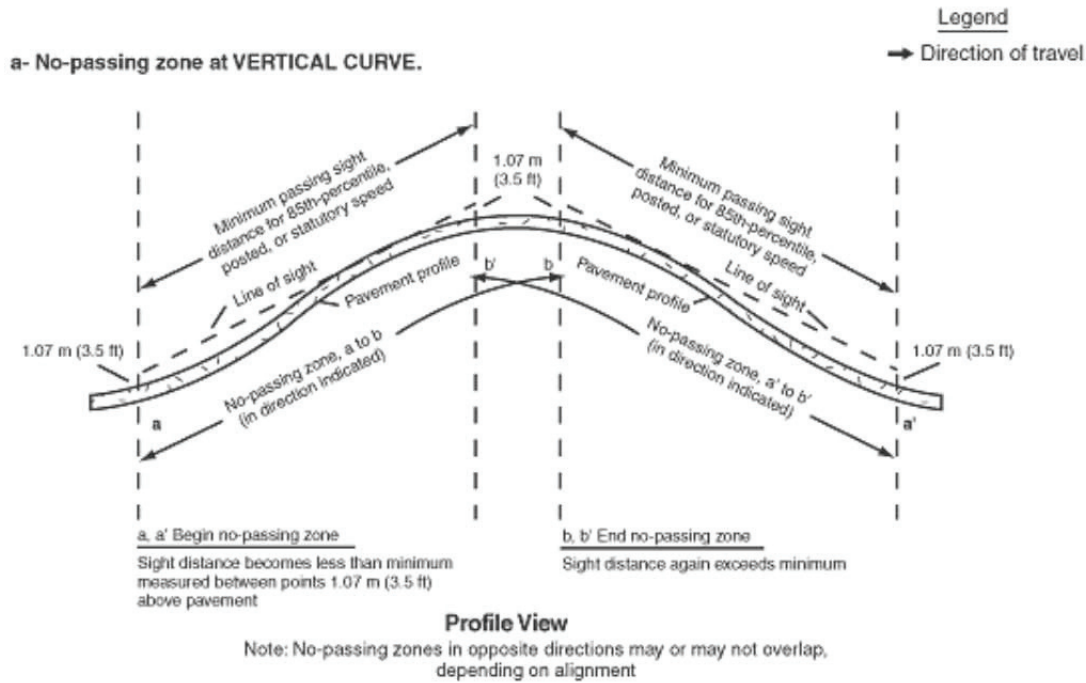


Figure 3B-5. Method of Locating and Determining the Limits of No-Passing Zones at Curves



b- No-passing zone at HORIZONTAL CURVE.

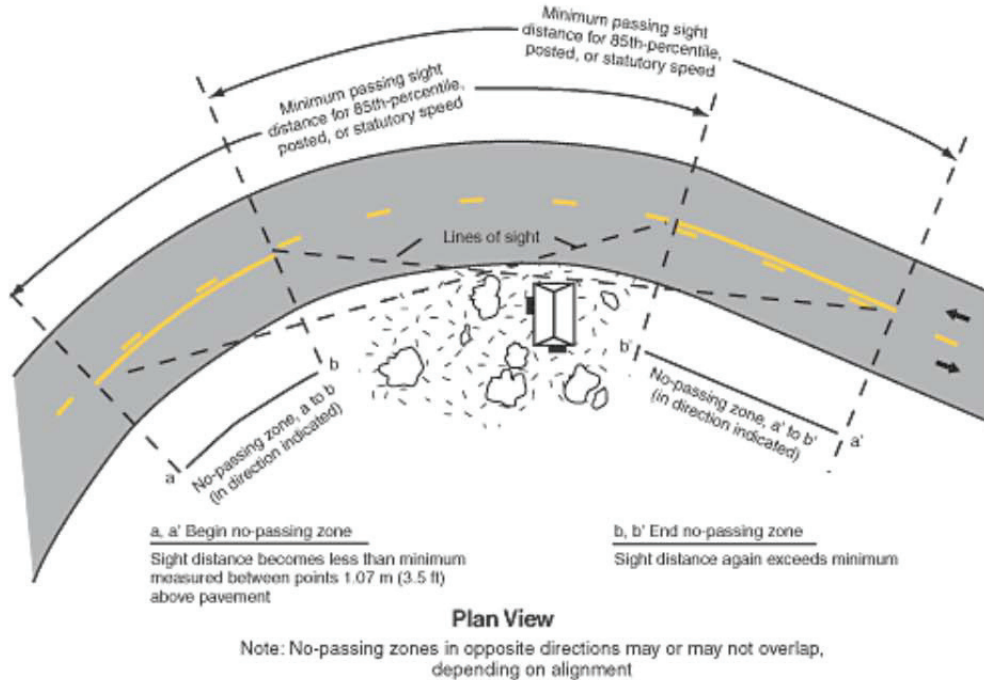
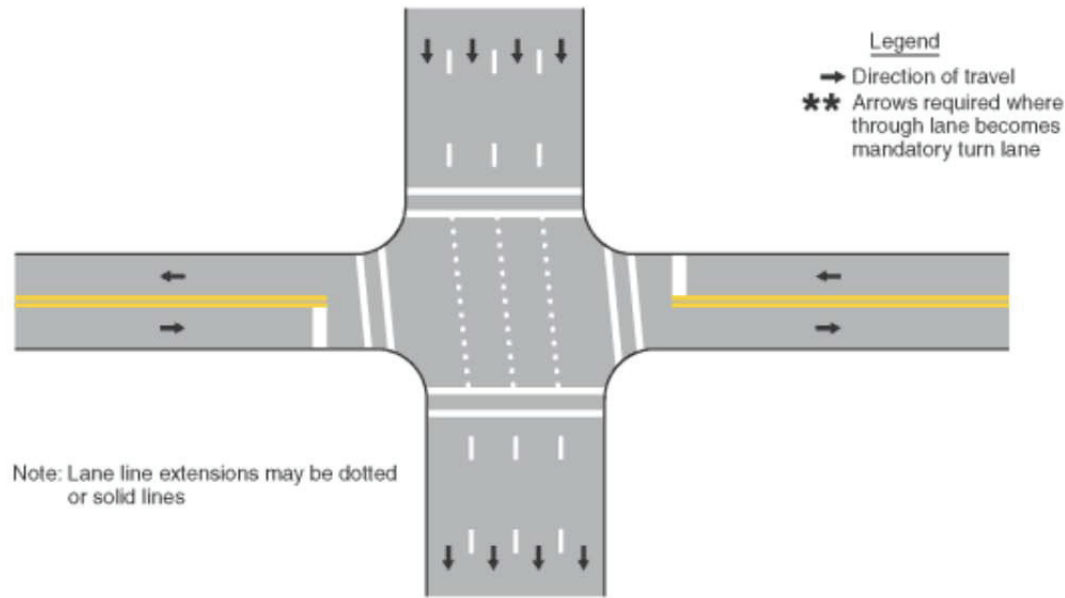


Figure 3B-11. Examples of Extensions through Intersections (Sheet 1 of 2)

a - Typical pavement markings with offset lane lines continued through the intersection and optional crosswalk lines and stop lines



b - Typical pavement markings with optional double-turn lane lines, lane-use turn arrows, crosswalk lines, and stop lines

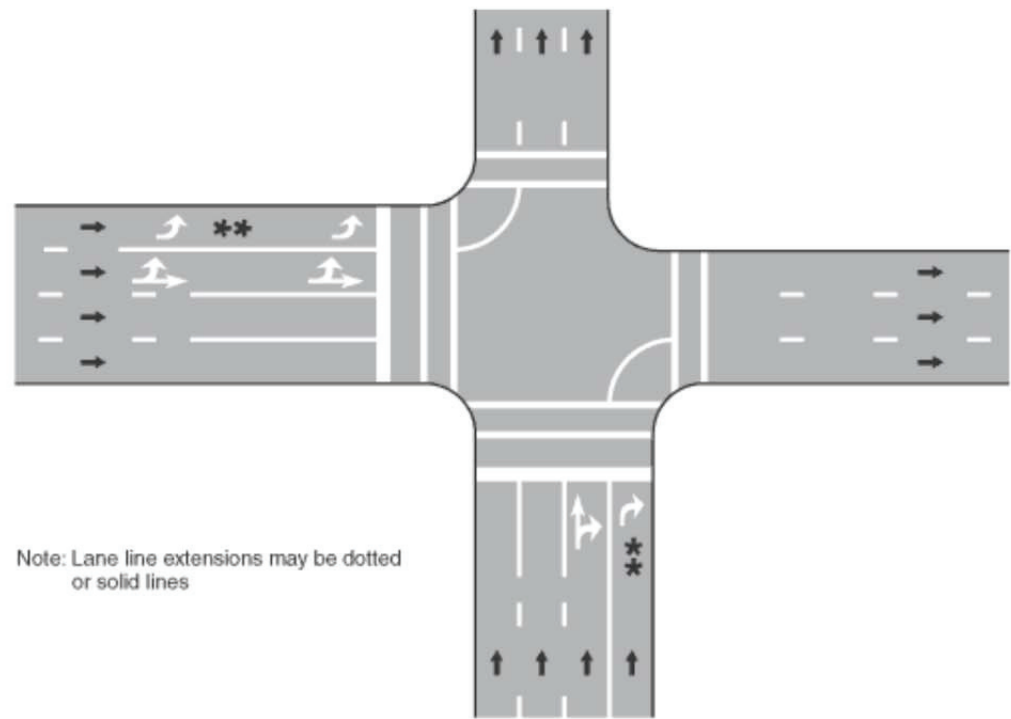
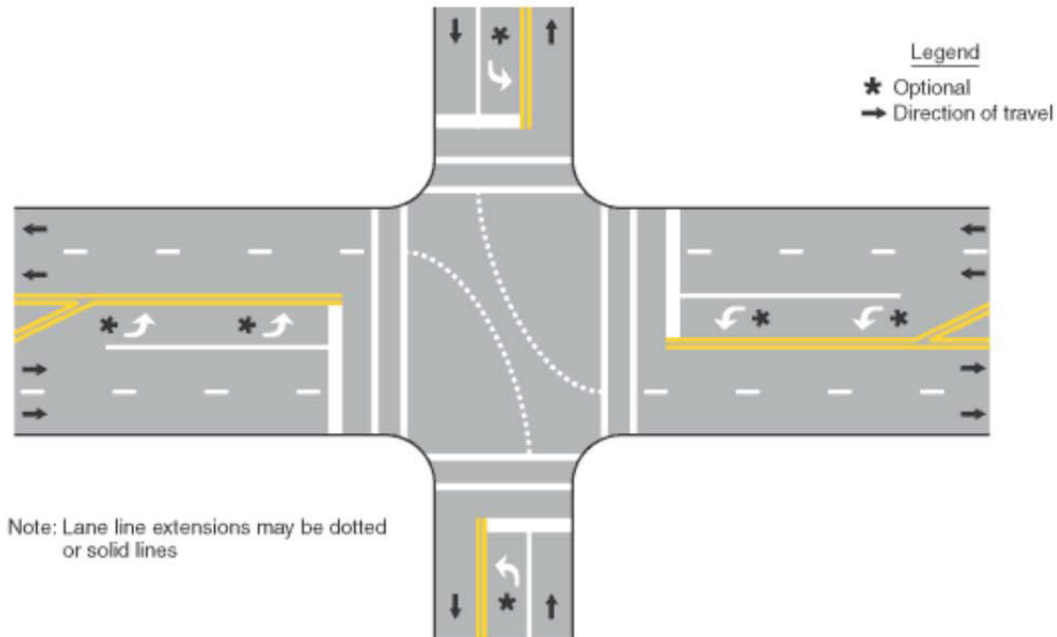
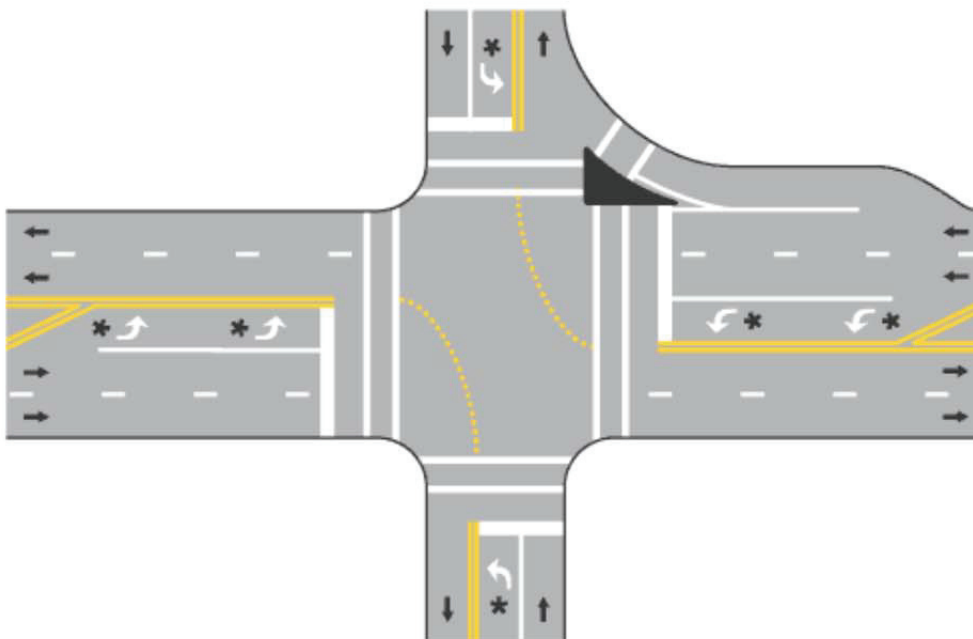


Figure 3B-11. Examples of Extensions through Intersections (Sheet 2 of 2)

c - Typical dotted line markings to extend longitudinal lane line markings



d - Typical dotted line markings to extend longitudinal centerline markings



Option: A normal line may be used to extend a wide line through an intersection.

Guidance: Where highway design or reduced visibility conditions make it desirable to provide control or to guide vehicles through an intersection or interchange, such as at offset, skewed, complex, or multilegged intersections, on curved roadways, or where multiple turn lanes are used, dotted line markings should be used to extend longitudinal line markings through an intersection or interchange area.

Option: Dotted edge line extensions may be placed through intersections or major driveways.

Guidance: Where greater restriction is required, solid lane lines or channelizing lines should be extended into or continued through intersections or major driveways. However, edge lines should not be extended into or continued through intersections or major driveways as solid lines

A single line of equal width to one of the lines of the double line should be used to extend a double line through an intersection.

To the extent possible, pavement marking extensions through intersections should be designed in a manner that minimizes potential confusion for drivers in adjacent or opposing lanes.

Section 3B.09 Lane Reduction Transition Markings

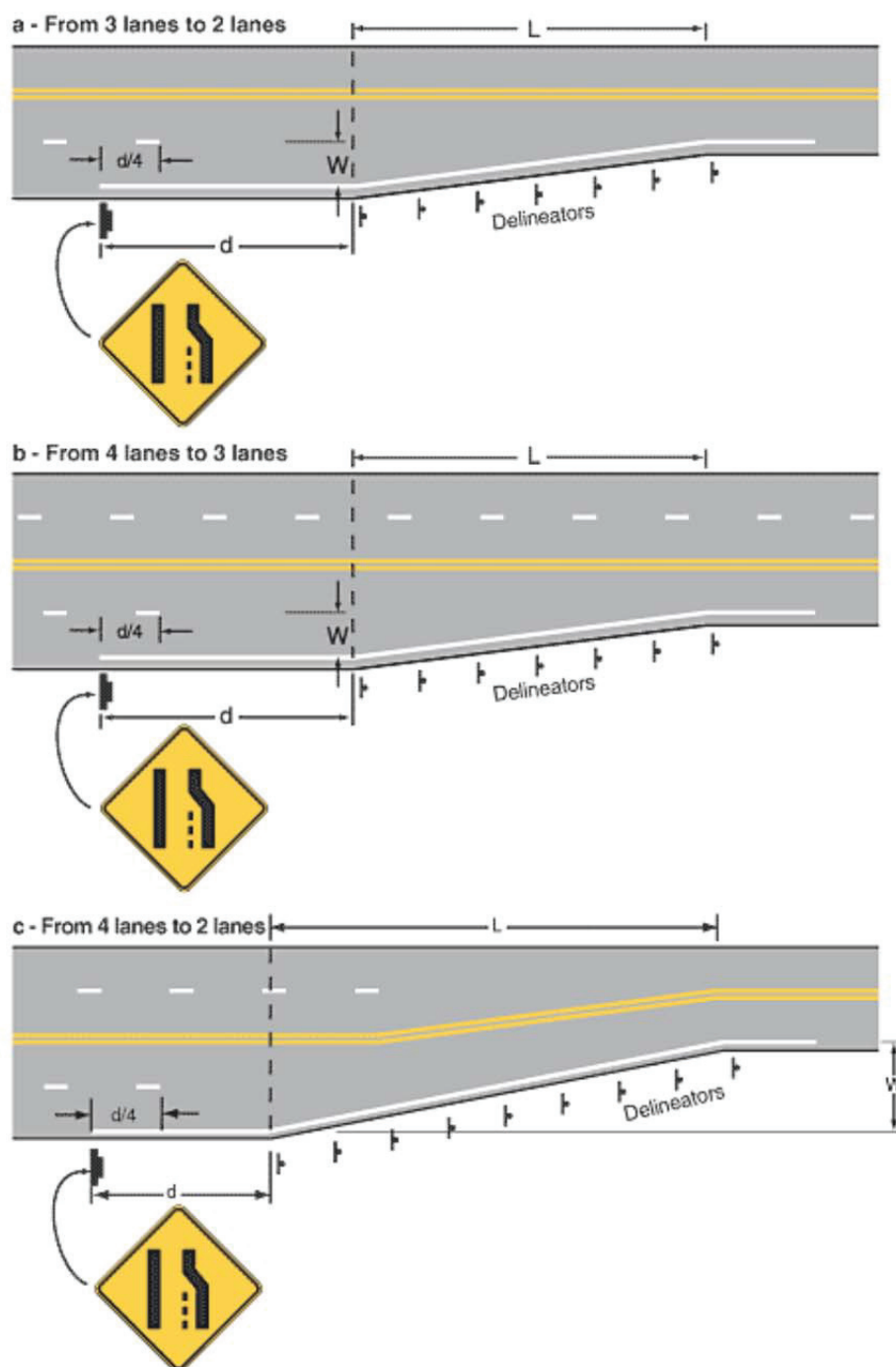
Standard: Where pavement markings are used, lane reduction transition markings shall be used to guide traffic through transition areas where the number of through lanes is reduced, as shown in Figure 3B-12. On two-way roadways, no-passing zone markings shall be used to prohibit passing in the direction of the convergence, and shall continue through the transition area.

Guidance: For roadways having a posted or statutory speed limit of 70 km/h (45 mph) or greater, the transition taper length for a lane reduction should be computed by the formula $L = 0.62 WS$ for speeds in km/h ($L = WS$ for speeds in mph). For roadways where the posted or statutory speed limit is less than 70 km/h (45 mph), the formula $L = WS^2/155$ for speeds in km/h ($L = WS^2/60$ for speeds in mph) should be used to compute taper length. Under both formulas, L equals the taper length in meters (feet), W equals the width of the offset distance in meters (feet), and S equals the 85th-percentile speed or the posted or statutory speed limit, whichever is higher. Where observed speeds exceed posted or statutory speed limits, longer tapers should be used.

Option: On new construction, where no posted or statutory speed limit is established, the design speed may be used in the transition taper length formula.

Guidance: Lane line markings should be discontinued one-quarter of the distance between the Lane Ends sign (see Section 2C.33) and the point where the transition taper begins. Edge line markings should be installed from the location of the warning sign to beyond the beginning of the narrower roadway.

Support: Pavement markings at lane reduction transitions supplement the standard signs.

Figure 3B-12. Examples of Lane Reduction Markings

L = Length in meters (feet)
 S = Posted, 85th-percentile, or statutory speed in km/h (mph)
 W = Offset in meters (feet)
 d = Advance warning distance (see Section 2C.05)
 See Section 3D.04 for delineator spacing.

For speeds 70 km/h (45 mph) or more:
 $L = 0.62 WS$ ($L = WS$)

For speeds less than 70 km/h (45 mph):
 $L = \frac{WS^2}{155}$ ($L = \frac{WS^2}{60}$)

References

See Appendix A for the following:

VDOT Road & Bridge Specification Book

Section 512.01 thru 512.02 (e)
Maintaining Traffic

Section 704.01 thru 704.03 (a)
Pavement Markings and Markers

Chapter 1 Knowledge Check

1. The purpose of pavement markings is to communicate information about the traveled roadway so motorists can safely reach their destination.
 - a) True
 - b) False
2. Standard markings shall only be used to convey the meaning prescribed for them in the Manual on Uniform Traffic Control Devices (MUTCD).
 - a) True
 - b) False
3. In Virginia, the normal specified width of a longitudinal line is:
 - a) 3 inches
 - b) 4 – 6 inches
 - c) 8 inches
4. The standard for a broken line separating traffic in the same direction at the same speed limit is:
 - a) 8 ft. segments with 30 ft. gaps.
 - b) 40 ft. segments with 10 ft. gaps.
 - c) 10 ft. segments with 30 ft. gaps.
5. Solid yellow lines are used to delineate the separation of traffic flows in:
 - a) opposing directions.
 - b) the same direction.
6. The left edge of divided highways and one way roads is delineated by:
 - a) double yellow solid lines.
 - b) a broken white line.
 - c) a broken yellow line.
 - d) a single solid yellow line.
7. White lines are used to delineate the separation of traffic flows in:
 - a) opposing directions.
 - b) the same direction.
8. Broken lines are restrictive in nature.
 - a) True
 - b) False

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9. The right edge of divided highways and one way roads is delineated by:
- a) double solid yellow lines.
 - b) a broken white line.
 - c) a single solid white line.
 - d) a single solid yellow line.
9. Broken lines are restrictive in nature.
- a) True
 - b) False
10. Solid lines are restrictive in nature.
- a) True
 - b) False
11. A double line consists of two normal width lines separated by a 3 inch space.
- a) True
 - b) False
12. A pavement marking plan or sketch may not be required before a road is marked, but is strongly encouraged.
- a) True
 - b) False
13. A chalk line is the only approved way of pre-marking a road.
- a) True
 - b) False
14. Traffic control is not required when pre-marking on low volume roads.
- a) True
 - b) False
15. Which document takes precedence over all others?
- a) Road and Bridge Specifications
 - b) Plans
 - c) Special Provision Copied Notes
 - d) Special Provisions
16. In the Road and Bridge Specifications Book, which section specifies that the publication, "Quality Standards for Work Zone Traffic Control Devices" be used?
- a) Section 704
 - b) Section 235
 - c) Section 512
 - d) Section 246